

## Appendix A.

### Submitted Environmental Fate and Transport Studies

#### Introduction

The environmental fate data base is incomplete, but is sufficient to allow for an environmental fate assessment of parent EPTC that generally fits the pattern suggested by the monitoring data which are available. Both soil metabolism and volatilization mechanisms are likely to be important in the dissipation of EPTC in field applications. Hydrolysis, photolysis, and sorption appear to be minor routes of dissipation.

The registrant has suggested that first step in the metabolic breakdown of EPTC in soils appears to be oxidation to the sulfoxide (ESO) (MRID 40420402). Additional sulfur and carbon oxidation (hydroxylation) leads to the formation of dipropylamine. Oxidation of the N-alkyl carbon side chain is supported by the release of  $^{14}\text{CO}_2$  from EPTC, ESO, and the amine. They report that others have proposed that a minor pathway is the metabolism is N-alkyl hydroxylation and the subsequent dealkylation. Sulfoxidation followed by the release of carbamic acid has been proposed as a major metabolic pathway in soil. The dealkylated products (not detected in registrant studies) are metabolized to  $^{14}\text{CO}_2$  in the soil. In the terrestrial field dissipation studies two degradates were detected in soil samples: EPTC-sulfoxide, and di-N-propylamine. Hydrolysis, photolysis, and sorption are not significant dissipation pathways for EPTC.

#### (1) Degradation

Hydrolysis 161-1 Based upon a limited number of registrant-sponsored studies, EPTC does not appear to be subject to abiotic hydrolysis under the conditions of these studies. Therefore, hydrolysis does not appear to be a significant dissipation pathway for EPTC.

The potential for EPTC to degrade through hydrolysis was determined by the registrant. Solutions of EPTC (90 ppm) were prepared with bacteria free water buffered at pH 5.0, 7.0, and 9.0. Aliquots of each solution were transferred to individual tubes and incubated for 30-days in the dark at 25°C and 40°C ( $\pm 0.5^\circ\text{C}$ ) in water baths. Analytical results at both temperatures and at each pH showed that no hydrolysis of EPTC (no hydrolytic loss of EPTC) occurred at either temperature or either pH (Reg. No. 476-2140, 476-2165) EAB# 5003, 50040; 12/06/84) (Meyers and Bartall, 1983, MRID # 00141373). Further there was no loss of EPTC in the Aqueous Photolysis Study (Spurgeon, 1989, MRID 42120803) conducted in a pH 7.0 solution at 25°C.

Direct photolysis in water (161-2) Based upon a limited number of registrant-sponsored studies, EPTC does not appear to be subject to direct photolysis, under the conditions of these studies. Therefore, direct photolysis does not appear to be a significant dissipation pathway for EPTC. EPTC was determined to photolytically stable (“no appreciable disappearance of  $^{14}\text{C}$ -EPTC occurred”) to photolysis in water based upon a study

(Spurgeon, 1989, MRID 42120803) determined to be acceptable and valid by the Agency (D172759).

Three studies to ascertain the direct photolysis rate of EPTC in water (161-2) were submitted to the Agency. One was determined to be acceptable, one was determined to be supplemental, and the third was determined to be invalid. EPTC did not photodegrade in sealed quartz tubes when continuously irradiated with a xenon lamp at 25 °C for 13.8 days, in the valid, acceptable study (Spurgeon, 1989, MRID 42120803). EPTC accounted for 94 to 103 percent of the radioactivity in the irradiated samples and 97 to 100 percent in the dark controls. The registrant indicated that the 13.8 days of continuous, irradiation with the xenon arc lamp was equivalent to 33.2 days of natural sunlight. Possible water degradates including EPTC sulfoxide (ESO)(3.4% of applied), EPTC sulfone (2%), N,N-dipropylformamide (1.9%) , dipropylamine (35.7%), and ethanesulfonic acid (unlabeled fragment- 5.4% radioactivity) were identified (MRID 40420401) in photolysis study determined to be unacceptable by EFED due using a light spectrum (blacklight) that did not correspond to natural sunlight.

Photolysis on soil (161-3) EPTC was shown to be stable to photodegradation on soil in an acceptable (D172759) study (Carpenter, 1989, MRID 42120804) submitted to the Agency. Therefore, photodegradation on soil does not appear to contribute significantly to the disappearance of EPTC.

Radiolabeled (<sup>14</sup>C)EPTC applied to a loamy soil surface did not photodegrade when continuously irradiated with a xenon lamp at 25 °C for 31 days. Parent EPTC comprised 90.8 to 102 percent and 83 to 101 percent of the applied radioactivity in the irradiated and dark control samples, respectively. Most of the radioactivity ( $\geq 94.5\%$  of the applied) was extracted from the sample with acidified methanol. Approximately 0.2 percent was recovered as unextracted, 1.5 percent was recovered from ethylene glycol and sulfuric acid traps, and 0.34 to 1.3 percent was recovered from the KOH traps. Material balances were 99.2 to 104 percent of the initial material.

**Outstanding Issues:** Several questions or points needing additional clarification were identified in the EFED review (D172759). The registrant still needs to respond to these items. Issues include why there was essentially no volatilization radioactivity in this study, when EPTC is so volatile. A contradiction between the analyses of some soil properties of the Keeton sandy loam also needs to be addressed.

Photolysis in air (161-4) EFED determined (D185069) that the photolysis in air data requirement was not met by the submission of a scientific publication (Kwok et al., 1992, MRID 42541001). The study was not long enough (single sampling), thus, no conclusions about the atmospheric half-life could be made. The study authors concluded that oxidation by OH<sup>-</sup> radicals are the dominant atmospheric loss processes once EPTC enters the atmosphere through volatilization. Study authors report that there was no atmospheric decay of gas-phase concentrations in air in the dark over 4 hours. The data indicated that in light EPTC would have a short atmospheric lifetime of less than 1 day due to its reaction with OH<sup>-</sup> radicals in the atmosphere.

Aerobic Soil Metabolism (162-1) The registrant conducted several studies Miaullis, 1987 (MRID 40420402), Miaullis and Parker, 1989a (MRID 42120805), and Miaullis and Parker, 1989b (42120806) to address the aerobic soil metabolism data requirement. Aerobic soil metabolism of EPTC does not appear to follow the natural log (ln) transformed first-order reaction rate equation ( $\ln C(t) = \ln C_0 - kt$ ) very well over the entire study duration. Instead, it appears to follow a "bi-phasic" pattern. The registrant and EFED scientists previously determined two loss rates (or half-lives) of EPTC using linear regression on ln-transformed data. Thus, the steeply sloping portion of the concentration versus time curve (initial times) was analyzed separately from the flatter portion (later times) of the curve. The steeper portion of the curve was defined as the initial phase and the flatter portion of the curve was defined as the secondary phase (Appendix 1, Table 2).

For this assessment, half-lives and decay rates of EPTC were determined using data from the entire duration of each study. The decay rate of EPTC appears to follow pseudo first-order type kinetics throughout the study duration when nonlinear regression is applied to the untransformed form the equation, ( $C=C_0e^{-kt}$ ) where  $C_0$  is the initial concentration,  $C$  is concentration,  $t$  is time, and  $k$  is the decay rate constant. The parameter  $k$  was estimated by non-linear regression of  $C$  versus time. The decay rate constant ( $k$ ) was also estimated using linear regression on the log-normal transformed data (Appendix 1, Table 2). Due to differences in soils chemical and physical properties, differences in microbial populations, and experimental conditions the degradation of EPTC doesn't result in a unique degradation (dissipation) rate, but results in a range of values.

The decay rate constants,  $k$ , were used to determine the half-lives ( $\text{rate} = \ln 2 / \text{half-life}$ ) or DT50. The half-life and DT50 are equivalent when conducting a linear regression on ln-transformed data or non-linear regression on untransformed data when using the "pseudo" first order kinetics model. Depending upon which method was used the half-life values ranged 10.3 to 74.9 days. The calculated coefficients of determination were closer to 1.00 for the non-linear regression (0.93-0.99) compared to the transformed linear regression (0.63-0.95).

The first study was conducted to obtain information on both aerobic and anaerobic soil metabolism (Miaullis, 1987). The same soil (Keeton sandy loam from CA) was used for both "redox" conditions Miaullis and Parker, 1989c (MRID 42120807). EFED determined that this aerobic soil metabolism study did not satisfy data requirements. Several recommendations were made as to what information would need to be submitted so that the data requirement could be fulfilled (D172759). This study (Miaullis, 1987) was determined to provide supplemental information by EFED, useful information concerning the metabolism and volatilization of EPTC were obtained.

The registrant proposed that EPTC degraded and volatilized in aerobic soil at two rates. The first rate suggested that EPTC degrades rapidly with a first half-lives of 14 to 21 days (half-life  $\approx 17$  days) (ln-normal transformation). A second slower rate of degradation also was determined to occur between 30 and 63 days (half-life  $\approx 47$  days) after 80% (excludes day 314) of original parent had dissipated was also suggested. EFED noted

that the data indicated that the aerobic soil half-life of EPTC would be longer than 17 days. A half-life of 74.9 days was estimated, using all the data, assuming that the ln-normal first-order degradation rate model was correct. The decay rate of EPTC appears to fit better a pseudo first-order type ( $C=C_0e^{-kt}$ ) relationship without transforming the data as indicated by the coefficient of determination ( $r^2 = 0.93$ ). The estimated rate of decline is  $0.026068 \text{ days}^{-1}$  ( $T_{1/2} = 26.6$  days). The half-lives were calculated from the EPTC residues extracted from soil, about 45% of the applied radioactivity had volatilized as parent by day 30. Volatilization was rapid as much of the volatilization occurred during the first seven days. Although the decline in EPTC soil residues appears to support the reported half-life of, volatilization contributed more to the initial decline than aerobic soil metabolism (as measured by  $\text{CO}_2$  and  $^{14}\text{CO}_2$  production).

EPTC sulfoxide (ESO) was the only degradate identified by TLC, with the average concentration reaching its highest value at 14 days (5.6% of applied, 0.33 ppm) and then decreased to 0.07 ppm (1.2%) at 63 days. In an associated study, the registrant added two degradates of EPTC (ESO and dipropylamine). The registrant indicated that the apparent half-life for EPTC, dipropylamine, and ESO was reported as 22-26 days, 7 days, and 13-14 days, respectively in the Bethany soil (stated to be from IL, no other data reported). These results indicate that ESO and dipropylamine are less persistent than EPTC in the study.

Two additional aerobic soil metabolism studies submitted by the registrant were determined to be scientifically valid and provide supplemental information (Miaullis and Parker, 1989a, b - MRIDs 42120805 and 42120806). Half-life values were obtained in a manner similar to that discussed for the previous study. These studies indicated that EPTC degraded and volatilized much more rapidly in the first phase (early part of study) in three soils under an aerobic soil environment. Half-lives ranged from between 12.7 and 27.7 days for the first phase. Slower rates degradation (half-lives 60.8 to 127.4) were determined in the second phase. ( $r^2$ s = 0.95-0.98). The EPTC sulfoxide degradate, ESO, was only degradate identified which never accounted for more than 6 percent (0.36 ppm) of the total residues.

Half-lives for the three soils included in this study were recalculated by EFED, using the pseudo first-order type ( $C=C_0e^{-kt}$ ) relationship without transforming the data. The regression equations obtained using nonlinear regression on all the untransformed data had better coefficients of determination ( $r^2$ s = 0.96 to 0.99) than the linear regression using ln-transformed data (0.63 to 0.95). The recalculated half-lives (or DT50s) ranged from about 10 to 37 days using the non-linear method and 36.5 to 74.9 days using ln-transformed data and linear regression..

EFED previously suggested that the aerobic soil half-life of EPTC (17days) may be longer than reported, because it combines volatilization and microbial degradation. EFED also determined the half-life, by excluding the amount collected in the "traps" to account for losses from volatilization. The recalculated half-life was 46 days. Although the decline of EPTC residues in soil was supported by the half-life (rate), volatilization contributed more to the initial decline than aerobic soil metabolism. Aerobic metabolism

may be of secondary importance in the decline of EPTC from these soils. In these studies, the decrease in EPTC residues was primarily due to volatilization since 33 to 81% of applied radio activity was present as volatile parent at end of the studies. EFED concluded that volatilization may be an important route of dissipation in the environment, even with incorporation.

Previous outstanding Issues: The recommendations to make the studies satisfy data requirements were made in the review. The outstanding issues included a contradiction (e.g., %organic matter) of the analysis of soil properties associated with the Keeton sandy loam.

Table 2. Summary of degradation rate constants and estimated half-lives for EPTC in three soils and upper 90<sup>th</sup> confidence bounds (MRID #s 42120805, 42120806, 40420402).

Soil	“Ln-normal transformed First-Order” Degradation Rate Constants - k (day <sup>-1</sup> ) (coefficient of determination) and Half-life (days) for EPTC by phase duration <sup>1</sup> .	
	Initial <sup>1</sup> [phase duration]	Secondary <sup>1</sup> [phase duration]
Keeton sandy loam <sup>2</sup>	0.0547 (0.96); 12.7 [0-31d]	0.0054 (0.98); 127.4 [31-205d]
Sorrento loam <sup>2</sup>	0.0250 (0.97); 27.7 [7-31d]	0.0095 (0.98); 73.0 [31-205d]
Atterberry silt loam <sup>2</sup>	0.0324 (0.98); 21.4 [7-80d]	na <sup>4</sup> ; 60.8
Keeton sandy loam <sup>3</sup>	0.0254 (0.96); 27.3 [0-63d]	0.0048 (0.95); 143 [63-314d]
	Data from entire duration of study included.	
	Pseudo First-order Integrated average (C(t) = C <sub>0</sub> exp(-kt) k (days <sup>-1</sup> ); Half-life (days)	Ln transformed Pseudo 1st-order ln C(t) = ln C <sub>0</sub> - kt k (days <sup>-1</sup> ); Half-life (days)
Keeton sandy loam <sup>2</sup>	0.067292 (0.96); 10.3	0.01170 (0.63); 59.2
Sorrento loam <sup>2</sup>	0.018772 (0.96); 36.9	0.01090 (0.95); 63.6
Atterberry silt loam <sup>2</sup>	0.030297 (0.99); 22.8	0.01900 (0.93); 36.5
Keeton sandy loam <sup>3</sup>	0.026070 (0.93); 26.6	0.00925 (0.79); 74.9
Rate <sub>a</sub> = mean ± t <sub>a</sub> * (std/√4) Rate <sub>0.9</sub> = 24.17 + 2.353*(10.99/√4) = 37.08 days (0.0187 days <sup>-1</sup> ) - Non-linear Rate <sub>0.9</sub> = 58.55 + 2.353*(16.12/√4) = 77.49 days (0.0089 days <sup>-1</sup> ) - Ln-transformed		

1. EPTC initially declined at a faster rate followed by a slower decline rate. The registrant consider the two rate class as phase. Phase duration represents the period of the study considered in each phase.
2. MRID Numbers 42120805 and 42120806.
3. MRID Number 40420402
4. na - Rate constant provided but appears to be the slope of a line between 2 data only.

Anaerobic Soil Metabolism-(162-2) The registrant submitted two studies to address the anaerobic soil metabolism data requirement (162-2). The first study (Miaullis, 1987 MRID 40430402) was determined to be scientifically valid and therefore able to provide supplemental information to EFED (D164295). EFED estimated the half-life as 127

days. EFED concluded that the anaerobic metabolism could be quite slow. These data suggested that the volatilization of EPTC contributed more to the initial decline of EPTC than did the anaerobic metabolism as measured by the evolution of CO<sub>2</sub>. The second study (Miaullis and Parker, 1989c, MRID 42120807) was also determined by EFED to be scientifically valid and adequate to provide supplemental information. The study shows that EPTC degraded and volatilized in three soils with estimated half-lives of between 31.4 days and 83.6 days. EPTC - sulfoxide (ESO) was the only degradate identified and never accounted for more than 0.01 ppm (<0.2%).

Anaerobic Aquatic Metabolism (162-3) No anaerobic aquatic metabolism data has been submitted for EPTC. Anaerobic aquatic metabolism (162-3) data are generally not required to support the registered uses of EPTC. EFED recommends that the registrant conduct one or more anaerobic aquatic metabolism (162-3) studies. This recommendation is due to the wide spread use of EPTC, high application rates, its low soil partition coefficient, and detections (wide spread) in surface water bodies. The environmental fate data and use profiles suggests that while there is a potential for EPTC to reach surface water exists, because of degradation and volatilization it is not very persistent in an aquatic environment. The rate of degradation in water will allow for a better understanding of the fate of EPTC in water where volatilization is limited (e.g., still water, deep water). This data would allow for a higher degree of certainty when assessing the fate of EPTC and its degradation products on water quality.

Aerobic Aquatic Metabolism (162-4) No aerobic aquatic metabolism data has been submitted for EPTC. Aerobic aquatic metabolism (162-4) data are generally not required to support the registered uses of EPTC. EFED recommends that the registrant conduct one or more aerobic aquatic metabolism (162-4) studies. This recommendation is due to the wide spread use of EPTC, high application rates, its low soil partition coefficient, and detections (wide spread) in surface water bodies. The environmental fate data and use profiles suggests that while there is a potential for EPTC to reach surface water exists, because of degradation and volatilization it is not very persistent in an aquatic environment. The rate of degradation in water will allow for a better understanding of the fate of EPTC in water where volatilization is limited (e.g., still water, deep water). This data would allow for a higher degree of certainty when assessing the fate of EPTC and its degradation products on water quality.

Soil Rf Factors (163-1) The EFED One-liner database reports a RF value of 0.56 for the Felton sandy loam.

Laboratory Volatility (163-2) EFED (DB Barcode D1722759) determined that the laboratory volatility study submitted by the registrant (McGahen, L. L. 1991, MRID # 42120809) was acceptable and satisfied the data requirements.

EPTC (non-labeled @ 99.8% purity and radiolabeled (N-propyl-1-<sup>14</sup>C-EPTC @ 99.4% purity and specific activity of 393 dpm/μg) was added to a sandy loam soil. Volatile EPTC was collected in foam plugs in the flow through system. Fifty-five percent of the total amount of EPTC volatilized during the first two hours of the study. The rate of

volatilization decreased with time and was essentially complete within four hours, where about 76 percent of the applied radioactivity volatilized during this period. The data also indicated that volatility is a potential major route of dissipation of EPTC in the environment. After 25 hours, the material balance averaged 99.1 percent. Parent EPTC was the only significant residue detected in the foam traps during the study.

Field Volatility (163-3) The registrant submitted a study conducted by the USDA (Cliath et al, 1980) to address field volatility data requirement 163-3 (MRID 40420404). EFED reviewed the submittal and determined that the study partially satisfies the data requirement.

EPTC can be applied through irrigation water, or chemigation. A study conducted by USDA researchers provides some information about the fate of EPTC when applied via the flood irrigation of alfalfa (Cliath et al., 1980). Cliath et al. (1980) reported the following when EPTC was applied in the flood-irrigation water. Of the 2.71 lb/ac applied (average concentration 2170 ppb), 73.6 percent volatilized (2.0 lb/ac) during the observation period of 52 hours. Seven percent (0.19 lb/ac, concentrations ranging between 1970 to 1440 ppb during observation period) of the applied EPTC was removed in the tailwater runoff. This suggests that EPTC concentrations in runoff water at a treated field edge can exceed 1000 ppb. Of the 73.6 percent measured to be lost through volatilization, 28.4 percent volatilized from water and 45.2 percent volatilized from wet soil. They determined that for this experiment, 80.6 percent of the EPTC applied to the alfalfa was lost through runoff and volatilization. It was concluded that losses could be reduced by reducing the amount of irrigation water lost as tailwater. These data indicate that volatility is a potential major route of EPTC dissipation in the environment

EFED further determined that additional information was needed on the volatilization of EPTC when it is soil incorporated in the field (D164295). In this assessment it was determined by EFED that field data should be submitted which assesses the volatilization of EPTC under typical use condition.

## **Mobility**

The affinity of EPTC to bind, or sorb, to four soils as reflected by the adsorption (Freundlich  $K_{ads}$  ~0.8 to 3.0) and desorption ( $K_{des}$  ~2.1 to 4.8) values appears to be relatively low (Table 3). Thus, considering the relatively low measured  $K_{ads}$  and calculated  $K_{oc}$  values (136-266) obtained, EPTC appears to have a medium to high potential for leaching. The percent EPTC in leachate and the  $K_{ds}$  estimated from the column leaching studies also indicated that EPTC has a high potential to leach. Its susceptibility to volatilization and biodegradation may modify its potential to contaminate ground water. The rates of volatilization and biodegradation will probably decrease with increasing depth below the soil surface. Overall the binding of EPTC appears to be relatively unimportant in the overall dissipation reactions of herbicide.



### Leaching/Adsorption/Desorption - (163-1)

The registrant conducted a batch equilibrium study to determine the Freundlich ( $K_{ads}$ ) and desorption values ( $K_{des}$ ) for EPTC (Spillner, 1988, MRID 42120808). The four soils considered in the experiment were the Keeton sandy loam, Columbia loamy sand, Sorrento loam, and the Atterberry silt loam. The selected soil properties are presented in Table 3. The calculated  $K_{ads}$ , assuming the Freundlich isotherm, for the four soils ranged from 0.77 to 2.99 mL/g (Table 3). The calculated  $K_{des}$  for the four soils ranged from 2.08 to 4.76. The  $n$  value in the slope term ( $1/n$ ) ranged from 1.05 to 1.15 for adsorption and desorption phases. EPTC adsorption by these four soils increased as soil organic carbon increased. Thus, the  $K_{oc}$  model appears valid (also statistically significant). For these soils the  $K_{oc}$  values ranged from 136-266 with a mean of 173. Previously, EFED determined that this study was acceptable and partially fulfilled the EPA data requirement

Table 3. Summary of four soils: selected soil properties, Freundlich slope,  $K_d$ , and  $K_{oc}$  for EPTC (Spillner, 1988, MRID 42120808).

Soil Series	%sand	%silt	%clay	pH	%OC <sup>1</sup>	CEC	Mean (of 2)		
							$n^2$	$K_d$ (std)	$K_{oc}$ (std)
Keeton	64.4	26.0	9.8	7.7	0.29	8.5	1.10	0.77 (0.02)	264 (8)
Columbia	80.2	14.0	5.8	7.8	1.1	12.2	1.06	1.61 (0.04)	146 (4)
Sorrento	45.6	34.0	20.8	6.8	1.8	20.7	1.04	2.57 (0.07)	143 (4)
Atterberry	17.8	56.4	25.8	5.6	2.2	24.6	1.10	2.99 (0.07)	136 (3)

<sup>1</sup> %OC is Percent soil organic carbon.

<sup>2</sup>  $n$  term in slope of the sorption isotherm ( $1/n$ ).

Leaching of aged and unaged EPTC (163-1) The registrant conducted EPTC aged and unaged leaching column experiments by applying radiolabeled <sup>14</sup>C-EPTC to the soil which was re-packed soil columns (McBain, 1987, MRID 404420403). The study was determined to be both scientifically valid and satisfying the data requirements 163-1 (D160491 or D164295) in conjunction with the leaching/adsorption/ desorption study (MRID 42120808, Spillner, 1988.). Four soil textures (loamy sand, sandy loam, loam, and clay loam), sieved to 1-mm, re-packed in columns to a depth of 30 cm with a vibrator. In the aged leaching study an average of 22 percent of the applied parent EPTC was recovered in the leachate. In the study, 9 percent of the applied parent was found in the leachates to the loam and clay loam soils, and 55 and 78 percent of the parent were found in the leachates of the loamy sand and sandy loam soils, respectively. In both the aged and unaged leaching columns, less than 0.01 percent of the applied <sup>14</sup>C found in the leachate were degradates (including EPTC sulfoxide). The  $K_d$  values estimated for EPTC in the four soils in this study were 0.38, 0.68, 1.82, and 1.28 for the sandy loam, loamy sand, loam, and clay loam, respectively.

It was noted by the study authors that total recoveries (mass balance) were low (68.6 and 85.3% of applied <sup>14</sup>C). They attributed the low recoveries to the volatility of the test

substance. This was determined to be a plausible explanation since a substantial amount (up to 80%) of the EPTC volatilized in the aerobic and anaerobic metabolism studies. Also in the laboratory volatility study (McGahen, 1991, MRID 42120809), up to 77 percent of the applied EPTC volatilized after four hours.

## **FIELD DISSIPATION**

Field Dissipation (164-1) Nine terrestrial field dissipation studies have been submitted (MRID #s 98250, 146934, 146935, 40420405, 40420406, 40420407, 42120810, 42120811, 41724305) by the registrant and reviewed by EFED (DP Barcodes D160491, D164295, D172759, D185069 - 9/22/95). These studies were determined to be unacceptable and thus did not meet the 164-1 statutory data requirement. EFED indicated that some, if not all, the studies could be upgraded. Until such time that the outstanding issues are addressed, these studies provide supplemental data. It was also noted that although some outstanding issues remain to be addressed by the registrant, EFED determined that EPTC was not persistent to moderately persistent in soil. It was also noted that EPTC did not appear to be mobile in soils, even though the Freundlich  $K_{ds}$  were less than 5. However, insufficient water (rain and/or irrigation) may have been applied to the study plots for significant leaching of EPTC residues to have occurred. These studies indicated that EPTC had dissipation half-lives of 2 to 56.8 days, with an average half-life of 12.6 days.

Several of the studies provide limited information on the degradates EPTC sulfoxide and di-N-propylamine. The data were not adequate to evaluate the formation and decline of degradates or their mobility. EFED recommended that the registrant submit data to assess volatilization under typical field use conditions (e.g., soil incorporated, watered-in, or applied via-chemigation). This will allow for a quantitative (or semi-quantitative) assessment of the loss of EPTC via volatilization.

MRID 98250 (Weidmann, J. et al., 1981). EPTC was applied (as PPG-1363 5E - a mixture of 12 parts EPTC and 1 part PPG-1292, a pesticide safener), at 4 or 6 lbs ai/ac, as broadcast, preplant incorporated onto unreplicated plots in five states (CO, KY, MN, NC, OH). The plots were rototilled after treatment. Corn was grown at the CO, NC, and OH sites. Crops at the other two sites were not specified.

Soil samples were collected (not specified) from 0 - 6 and 6 -12 inch depths for each location starting at the day of treatment and extending up to 269 days post treatment. The limit of detection was 0.01 ppm ( $\mu\text{g/g}$ ) with a method recovery of 93 to 103 percent from test soils fortified with EPTC at 0.12 ppm.

Soils at the five sites ranged from sandy loam to clay loam. EFED calculated the half-lives. Values ranged from 9.9 to 56.8 days. The  $R^2$  ranged from 0.12 to 0.97. EFED further indicated that, based upon laboratory studies, that volatilization could be a significant route of dissipation in the field even with soil incorporation.

MRID 146934 (Lee and Kleinschmidt, 1985). EPTC (10-G) was applied to bare ground

(2 replicate plots) plots, pre-plant, at a rate of 3.0 lb ai/ac with a boom sprayer to a sandy loam soil (1.5% organic matter, pH 6.7) and incorporated to a depth of 3 inches by rototiller, in Leland, MS. The study was started in July, rather than in spring, when pre-plant chemicals are normally applied.

Soil samples were collected on days 0, 14, 31, 62, 92, and 207 days after treatment. Sixteen soil samples (1-in diameter cores) were collected at a soil depth of 0-3, 3-6, and 9-12 inches. The samples were composited by depth which resulted in one composite sample for each time interval, per replicate. Samples were frozen until analyzed. Soil, fortified with 0.05 ppm EPTC, exhibited analytical recoveries ranging from 76 to 98 percent. EPTC, at 3 lb ai/ac, dissipated with a calculated half-life of 16.9 days in the upper 6 inches of a bare, sandy loam field plots. Information addressing soil and air temperature, precipitation, and irrigation amounts were not provided.

MRID 146935 (Kleinschmidt and Lee, 1985) EPTC (Eptam 10-G) was applied to bare ground plots (3 replicates) to a St. Johns fine sand at 3.0 lb ai/ac (0.5 organic matter, pH 5.4) in Sanford, FL by tractor mounted boom sprayer. The EPTC was incorporated to 2 inches with a rototiller.

Soil samples were collected on 0, 14, 29, 62, 93, and 182 after treatment. Fifteen 1-inch diameter soil cores were collected at a depth of 0-3, 3-6, 6-9, and 9-12 inches per replicate. The samples were composited by depth which resulted in one composite sample for each time interval. Samples were frozen. Soil, fortified with 0.05 ppm EPTC, exhibited analytical recoveries ranging from 100 to 106 percent. EPTC, at 3 lb ai/ac, dissipated with a calculated half-life of 7.7 days in the upper 3 inches of a St. Johns fine sand field plots. Information addressing soil and air temperature, precipitation, and irrigation amounts were not provided.

This study was determined to be unacceptable because the sampling intervals were too infrequent to accurately assess the dissipation of EPTC in the soil. For most of the samples, EPTC was only detected at day 0 and 14 and 98 percent of the applied EPTC dissipated during the first sampling interval. There was no identified route of dissipation.

MRID 40420405 (Curry, 1987) EPTC (Eptam 10-G) was applied (6 lb ai/ac) on April 18, 1996 to a silt loam soil (21.5% sand, 11.4% clay, 0.5% organic matter, pH 6.6) in MS by a granular applicator. The granules were incorporated to a depth of 3 inches with a rotary tiller to three replicate plots. There were also three untreated control plots. Potatoes were planted 2 inches in the plots on April 22.

Soil samples were collected, 0, 3, 7, 17, 27, 55, and 87 days, after treatment. Samples from each replicate consisted of a composite of ten 1-inch soil cores randomly selected from the treated and untreated plots and composited into one sample by depth (0-3', 3-6', and 6-12'). Samples were frozen after collection. Recoveries from soils fortified at 0.01 and 1.0 pp ranged from 80 to 105 percent with a CV of 14%.

EFED determined (D164295) that this study provided supplemental information. The

EPTC dissipated from a silt loam soil with a calculated half-life of 6 days. EPTC did not appear to substantially leach from the area of application (0-3 inch depth) to lowest sampling depth (6-12 inches). EPTC residues declined from the high (on day of application) of 2.48 µg/g to less than the detection limit of 0.01 µg/g by the 55<sup>th</sup> day after treatment in the 0-3 inch samples. EPTC was detected, in the 6-12" soil sample, on day 3, 7, and 17 after application, 0.16, 0.08, and 0.03 µg/g, respectively. After these sampling dates, EPTC was less than the detection limit.

MRID 40420406 (Curry, 1987). EPTC (Eptam 10-G) was applied (6 lb ai/ac) on May 9, 1996 to a loam soil (48.0% sand, 21.0% clay, 1.5% organic matter, pH 7.9) in CA by a granular applicator. The granules were incorporated to a depth of 3 inches with a rotary tiller to three replicate plots. There were also three untreated control plots. Green beans were planted immediately after the application of EPTC.

Soil samples were collected, -2, 0, 3, 7, 10, 14, 31, 61, and 91 days, after treatment. Samples from each replicate consisted of a composite of five 1-inch soil cores randomly selected from the treated and untreated plots and composited into three samples by depth (0-3', 3-6', and 6-12') for each plot. Samples were frozen after collection. Recoveries from soils fortified at 0.01 and 1.0 pp ranged from 90 to 103 percent with a CV of 7.0 %. The results of the soil analyses were not corrected for soil moisture content.

EFED determined (D164295) that this study provided supplemental information. The EPTC dissipated from a loam soil in CA with a calculated half-life of 8 days. EPTC did not appear to leach from the area of application (0-3 inch depth) to lower depths (3-6 and 6-12 inches). EPTC residues declined from the high (on day of application) of 2.94 µg/g to less than the detection limit of 0.01 µg/g by 61 day after treatment in the 0-3" samples. EPTC was detected, in the 3-6" soil sample, on day 3, 7, 10, and 14 after application, 0.14, 0.04, 0.02, 0.01, and 0.01 µg/g, respectively. Similarly, on day 0, 3, 7, 10, and 14 days after application, 0.38, 0.07, 0.04, 0.02, and 0.01 µg/g of EPTC, respectively was detected in the 6-12" soil depth. After these dates, no residues of EPTC greater were less than the detection limit for both depths.

MRID 40420407 (Curry, 1987). EPTC (eradicane) was applied at 6 lb ai/ac (0.89 gal of eradican 6.7-E per acre) with a boom sprayer to three replicate plots on May 9, 1986, followed by incorporation to a depth of 2 inches with rotary tiller. Three untreated control plots were also established. Corn was planted immediately after the application of the eradican to a loam soil (48.0% sand, 21.0% clay, 1.5% organic matter, pH 7.9).

Soil samples were collected from treated and untreated plots at -2, 0, 3, 7, 10, 14, 31, 61, and 91 days after treatment. Each sample from each replicate consisted of five 1-inch diameter soil cores collected from each plot. These samples were composited in to one sample per depth (0-3, 3-6, and 6-12 inches for each plot and time after application. A total of 22.09 inches of irrigation water was added to the corn plots, by sprinklers, to maintain the corn crop. Recoveries from soils fortified at 0.01 and 1.0 pp ranged from 100 to 110 percent with a CV of 4%. The results of the soil analyses were not corrected for soil moisture content.

EFED determined (D164295) that this study provided supplemental information. The EPTC (eradicane 6.7E) dissipated from a loam soil in CA with a calculated half-life of 4.8 days. EPTC did not appear to leach substantially from the area of application (0-3 inch depth) to lower depths (3-6" and 6-12 inches).

EPTC residues declined from the high (on day of application) of 4.92 µg/g to less than the detection limit of 0.01 µg/g after 61 days after treatment in the 0 to 3" samples. EPTC was detected, in the 3-6" soil sample, on day 0, 3, 7, 10, and 14 after application, 0.40, 0.06, 0.04, 0.01, and 0.01 µg/g, respectively. Similarly, on day 0, 3, 7, 10, and 14 days after application, 0.38, 0.06, 0.08, 0.02, and 0.02 µg/g of EPTC, respectively was detected in the 6-12" soil depth. After these dates, no residues of EPTC greater were less than the detection limit for both depths. The data showed that EPTC residues decreased within one month after application to less than 10% of the initial concentration and were not detectable after 61 days.

MRID 42120810 (Curry, 1989). A bare ground study was performed on a Cajun sandy loam soil (Coarse-loamy, mixed, Thermic Typic Torrisamments, 50% sand, 12% clay 0.8% organic matter, pH 8.0) near Porterville, California. The test plot was divided into three replicated subplots. A single untreated plot was established up-slope from the treated subplots. Before application, the soil was disked and harrowed and 2 inches of irrigation was applied on July 15, 1988. EPTC (60 lb/acre, 567.8 mL of Eptam 7-E with 7 gallons of water) was applied on July 22, 1988 with a tractor mounted boom sprayer and immediately incorporated with a rotary tiller to a depth of 3-4 inches. Immediately after application 0.64 inches of irrigation was applied to enhance incorporation. Rainfall and irrigation through the 91 days after application totaled of 7.51 inches of water.

Soil samples were collected at 0, 1, 3, 7, 13, 28, 58, and 91 days after application. Samples were taken from 0-3.5, 3.5-7.0, 7.0-10.5, 10.5-15.5, 15.5-27.5, and 27.5-39.5 inches. Within the treated plots, 3 or 7 soil cores were collected and composited according to depth. Samples were frozen. Untreated control soil samples were fortified with either 0.01, 0.05, 0.1, 0.50, or 4.0 ppm EPTC or EPTC sulfoxide. For di-N-propylamine soil was fortified with 0.01, 0.05, or 0.1 ppm concentrations. The average recovery of EPTC was 98 percent (82-110%), EPTC-sulfoxide was 98 percent (62-136%), and di-N-propylamine was 94 percent (70-105%). The reported detections limits were 0.01 ppm for EPTC, EPTC-sulfoxide, and di-N-propylamine.

This site was determined to be supplemental by EFED (D172759). EPTC residues were detected in the upper 7 inches of soil during the first 60 days of the study. By 91 days after application, EPTC residues decreased below the detection limit. No residues were detected below 7 inches. A half-life of 2 days was calculated for EPTC, using non-linear regression. EPTC-sulfoxide was at the maximum concentration of 0.099 ppm in the top 3.5 inches of the soil on the day of application. By 60 days after application, all EPTC-sulfoxide residues were below the detection limit. EPTC-sulfoxide was detected (0.01-0.23 ppm) in the 3.5-7 inch soil samples collected on the 1<sup>st</sup> day through the 28<sup>th</sup> day after EPTC application. None was detected below the 7 inch sampling depth. Di-N-

propylamine reached its maximum concentration of 0.041 ppm in the top 3.5 inches of soil on day 14 after application. It was only found on day 14 at the 3.5-7 inch depth (0.014 ppm). The analyte was not detected below 7 inches in any of the soil samples collected during the study. The amount of water added during the study as rainfall or irrigation may have been inadequate to cause leaching. The weather data from Bakersfield, CA (PRZM met17) indicates that precipitation during the course of study (1948-1983) ranges from 0 to 1.56 inches and that evaporation (evaporation pan) for the period ranges from 27 to 32 inches. Since the sum of irrigation and rainfall was only about 25 percent of evaporative demands it is unlikely that significant leaching occurred during the study.

MRID 42120811 (Wyatt, 1989). A bare ground study was performed on a Foster sandy loam soil (Coarse-loamy, mixed, Thermic Aquic Haploxerolls, 65% sand, 10% clay 0.6% organic matter, pH 8.1) near Visalia, California. The test plot was divided into three replicated subplots. A single untreated plot was established up-slope from the treated subplots. Before application, the soil was leveled to break the plow pan. EPTC (60 lb/acre dry granule Eptam, 10% ai) was applied on May 5, 1988 and immediately incorporated with a rotary tiller to a depth of 2-4 inches. After the post application soil samples were collected, 0.25 inches of irrigation was applied to the plots in addition to 0.28 inches of precipitation. The plots were irrigated through 61 days after application with a total of 8.88 inches of water.

Soil samples were collected at -2, 0, 1, 3, 7, 13, 28, and 61 days after application. Samples were taken from 0-3.5, 3.5-7.0, 7.0-10.5, 10.5-15.5, 15.5-27.5, and 27.5-39.5 inches. Within the treated plots, 3 or 7 soil cores were collected and composited according to depth. Samples were frozen. Untreated control soil samples were fortified with 0.01-3.00 ppm EPTC, 0.01-0.10 ppm EPTC sulfoxide, and 0.01-0.50 ppm di-N-propylamine. The average recovery of EPTC was 101 percent (91-107%), EPTC-sulfoxide was 90 percent (75-128%), and di-N-propylamine was 94 percent (71-126%). The reported detections limits were 0.01 ppm.

This study was determined to be supplemental by EFED (D172759). EPTC residues were detected in the upper 7 inches of soil during the first 28 days of the study. By 61 days after application, EPTC residues had decreased below the limit of detection. No EPTC residues were detected below 7 inches. The amount of water added to the study as rain or irrigation may have been inadequate to cause leaching. The half-life for EPTC for this study was 7 days. EPTC-sulfoxide was at a maximum concentration (0.10 ppm) in the top 3.5 inch layer on day 13 after application. By 61 days after application, EPTC-sulfoxide had decreased below the detection limit in the top 3.5 inches. Di-N-propylamine, was detected at every sampling date, reached a maximum concentration in the top 3.5 inches of soil 7 days after application and decreased to less than the detection limit 91 days after application. Di-N-propylamine was detected (0.012-0.074 ppm) in the 3.5-7.0 inch depth on days 7 to 61 after the EPTC was applied. Di-N-propylamine was also detected, 0.013 ppm) below 7 inches on day 13.

MRID 41724305 (Curry, 1990) A study was performed on a Foster sandy loam soil (Coarse-loamy, mixed, Thermic Aquic Haploxerolls, 55% sand, 12% clay 0.9% organic matter, pH 8.2) near Visalia, California. The test plot was divided into three replicated subplots. A single untreated plot was established up-slope from the treated subplots. Before application, the soil was leveled to break the plow pan, disked, packed with a ring roller, and harrowed. Alfalfa was planted on March 7, 1989. EPTC (60 lb/acre dry granule Eptam, 10% ai) was applied four times, May 16 and 30, June 13 and 26 for a total of 24 lb ai/ac. Immediately after the post application soil samples were collected, up to 0.99 inches of water was applied using sprinklers. Irrigation during the study was 33.03 inches. The application rate and total amount of EPTC used in this study appears to be greater than indicated by label information (2-4 lb ai/ac with maximum 12 per season). The 24c allows rates up to 6.1 lb ai/ac, but no maximum was indicated.

Soil samples were generally collected at 0, 1, 3, 7, and 14 days after the first three applications and 0, 1, 3, 7, 14, and 28 days after the final application. Samples were taken from 0-6, 6-12, 12-18, 18-24, 24-30, 30-36, and 36-48 inches. Within the treated plots, 3 or 7 soil cores were collected and composited according to depth, 6 or 10 soil cores were collected from the control plot and composited. Samples were frozen. Untreated control soil samples were fortified with 0.01-2.00 ppm EPTC and EPTC sulfoxide, and 0.01-0.50 ppm di-N-propylamine. The average recovery of EPTC was 103 percent (94-108%), EPTC-sulfoxide was 88 percent (78-97%), and di-N-propylamine was 93 percent (83-108%). The reported detections limits for EPTC, EPTC-sulfoxide, and di-N-propylamine were 0.01 ppm.

This study was determined to be supplemental by EFED (D172766?, D160491, D164295, D172759, D185069). EPTC (10-G) dissipated from the California Foster sandy loam, cropped in alfalfa, after each application (1 to 4) with calculated half-lives of 6, 3, 6 and 3 days for each application, respectively. EPTC residues were detected in the upper 6 inches of soil during the post application day 0 to 14 days following each of the first three applications. No residues were detected below 6 inches. The maximum concentration of 0.93 ppm occurred in one sample after the second application. EPTC residues decreased to or below the detection limit (0.1 ppm) by day 14 after the last application. Seven days after the last application EPTC sulfoxide residues dropped below the detection limit. Discrepancies concerning low storage recoveries were noted by EFED. Di-N-propylamine was detected (0.011 ppm) on day 0 and day 1 after the second application, only, in the upper 6 inch soil samples. It is not clear whether enough irrigation and rainfall occurred during the study to result in leaching.

## **ACCUMULATION**

Accumulation in Rotational Crops, Confined (165-1) (MRID 00152457)

Accumulation in Rotational Crops, Field (165-2) The EFED one-liner database indicates that EPTC is unlikely to accumulate in wheat, sugar beets, and soybean plants. The study is indicated to be valid, but no specific information concerning the source of this

information was available.

#### Accumulation in Irrigated Crops, (165-3)

Bioaccumulation of EPTC in Fish (165-4) EFED determined (D160491, D164295, D172759, D185069) that the studies submitted by Forbis (1987, MRID 40575101) and Halls and Heitkamp (1988, MRID 40575102) were scientifically valid and provide supplemental information. Halls and Heitkamp (1988) showed [ $^{14}\text{C}$ ]EPTC did not accumulate in bluegill sunfish exposed to [ $^{14}\text{C}$ ]EPTC at 0.084 ppm in a flow-through system for 28 days. The bioconcentration factor (BCF) in the flow-through accumulation study was 97X for viscera and 34X for fillet.

The bioaccumulation and elimination of [ $^{14}\text{C}$ ]EPTC by bluegill sunfish was investigated in a dynamic flow-through system (Forbis, 1987). The flow system was comprised of two aerated tanks containing 70 liters of water. The treated tank received the [ $^{14}\text{C}$ ]EPTC (specific activity  $3.41 \times 10^9$  dpm, 99% radio purity diluted to 1270 dpm/ $\mu\text{g}$ ) from a stock solution. The treated and control tanks received 120 fish. The fish were exposed for 28 days to the radiolabeled material at  $22 \pm 2^\circ\text{C}$ , followed by depuration in EPTC free water for 14 days. Fish and water samples were collected after 4-hours, 1, 3, 7, 14, 21, and 28 days after both EPTC-treated water and the EPTC-free water. Fish were sectioned into edible and nonedible (viscera) portions to analyze. During the exposure period, tissue concentration in the fillet, viscera, and whole fish increased from 0.6 to 3.1 ppm, 1.9 to 9.2 ppm and 1.7 to 5.0 ppm, respectively. Recovery of [ $^{14}\text{C}$ ]EPTC residues in water, nonedible, and edible fish tissue at sampling days 21 and 28 were, respectively 88.6 and 92.8%, 88.5 and 84.6% and 91.4 and 99.7%. Bioconcentration factors were 37X, 60X, and 110X, respectively, in the edible, whole fish, and non-edible fish tissues. The study did not meet data requirements because no storage stability data were submitted by the registrant. Fish samples were frozen and stored up to 7 months before analysis

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